IN THE MATTER OF US-Patent Application

Serial number: 10/583,749

Filed: 21 June 2006

based on: Int. Appl. no. PCT/AT 2004/000437
Int. filing date: 13 December 2004

DECLARATION

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do hereby declare that I am conversant with the English and German languages and am a competent translator thereof. I further declare that to the best of my knowledge and belief the following is a true and correct translation of the text of the description, claims and abstract of the above mentioned International (PCT) application (and amended pages).

Signed this 6th day of November 2006

C. Hopwood
(Signature of Translator)

Telescopic load-carrying device *[and method for the operation thereof]*

The invention relates to a load-bearing means of the type described in the introductory part of claim 1 and an operating method of the type described in the introductory part of claim 40.

Document DE 42 05 856 A1 discloses a device for bearing loads, with a telescopic load-bearing means comprising a bottom part, a top part provided in the form of a slide and supports disposed in between. The supports and the top part can be displaced in a plane parallel with a support surface for the load relative to one another and with respect to the bottom part in roller guides. To this end, the supports have longitudinally extending guide grooves in which the guide rollers rotatably mounted on the bottom part and on the slide run. A frictional or non-positive driving connection is also produced by friction gears or toothed gears rolling on friction surfaces or toothed racks of the top part and bottom part, which are mounted so as to rotate loosely on the supports. A drive connection of this type enables the top part to be displaced depending on the displacement of the supports by means of a single drive acting between the bottom part and the slide.

Document DD 74 496 discloses a load-bearing means for stacking devices, shelf-stacking devices or similar, which is of a telescopic design and has a telescopic rail between a bottom part and a top part with longitudinally oriented guide grooves for accommodating guide rollers rotatably mounted on the top part and on the bottom part and which enable the parts to be displaced and guided relative to one another. A drive system comprises a gear-toothed rack system for driving the telescopic rail relative to the bottom part. A transmission system for displacing the top part in relation to the displacement of the telescopic rails with respect to the bottom part is provided in the form of gears, rotatably mounted in the telescopic rail and in the bottom part, and toothed racks disposed in the top part which mesh with one another.

Document US 4,458,808 A discloses another telescopic table used as a load-bearing means with a stationary frame and an intermediate frame which can be displaced linearly relative to it in roller systems and a top table which can be displaced relative to it in roller systems. A drive system in the form of a chain and sprocket wheel is provided between the stationary frame and the intermediate frame. In order to provide a drive coupling for the top table,

strand-shaped transmission means in the form of chains are disposed in a complementary arrangement between anchoring means on the top table and stationary frame and sprocket wheels rotatably mounted on the intermediate frame. The complementary disposition enables the top table to be moved at both ends depending on the relative movement between the stationary frame and the intermediate frame.

Document US 2003/0185656 A1 discloses another load-bearing device with synchronously displaceable telescopic sliding arms with a middle carriage and a top carriage. The latter can be displaceably guided in lateral and height guide track of a support frame made from a hollow section and can be displaced relative to the support frame and relative to one another. The lateral and height guide tracks are formed by linear slide bearing systems. Disposed between the stationary support frame and the middle carriage in order to displace the latter, a chain and sprocket wheel with a reversible drive motor is provided on the support frame and the drive connection for displacing the top carriage depending on the relative movement between the support frame and the middle carriage is provided in the form of strand-shaped transmission means running in a complementary arrangement and preferably provided in the form of cogged belts, each with fixed anchoring means on the support frame and top carriage and turned around freely rotatable sprocket wheels disposed at opposite end regions of the middle carriage.

The objective of the invention is to propose a telescopic load-bearing means which, whilst being of a simple construction, is distinctive due to a minimized construction height and low weight and hence high capacity usage and short operating cycles.

This objective is achieved by the invention on the basis of the features defined in the characterizing part of claim 1. The surprising advantage of this approach is that, because of the separately disposed guide planes for the height guide and a guide plane for the lateral guide oriented perpendicular thereto, combined with the guide plane of transmission means of a transmission system extending at an angle to the guide planes, the tables driven into the shelving region to deposit or retrieve storage aids can be made to small cross-sectional dimensions. Due also to the high guiding accuracy which can be achieved, the driving-in height which has to be left free overall between a storage aid bottom face and a storage aid top face can be kept small, as a result of which a warehouse shelving system operated us-

ing the storage aid proposed by the invention has a high stacking factor, i.e. has a small proportion of non-usable empty capacity relative to the total storage volume, which also means shorter travel paths for the transport mechanism or for the shelf-stacking device for comparable storage capacities, and all of these factors make both the warehouse and the transport mechanism significantly more economic.

Other embodiments defined in claims 2 to 7 are also of advantage because high values can be achieved for the strength of the load-bearing components for a low intrinsic weight, thereby enabling high travel speeds of the shelf-stacking device and high speed movements of the loading platform and telescopic table carrying the load-bearing means to be achieved, whilst keeping energy consumption low, thereby resulting in shorter stacking and retrieval times and high capacity usage.

This being the case, fiber-reinforced composite components are used, using plastic reinforced with glass, carbon or Kevlar fibers as the composite material, resulting in a high modulus of elasticity so that the components have a high bending resistance, which means that the components can be made to smaller dimensions than would otherwise be the case if using other materials, such as Al alloy for example. Furthermore, in addition to achieving high strength, another advantage is that a warehouse equipped in this manner is more economic overall due to the use of less expensive materials and production methods.

An embodiment of the type defined in claim 8 enables the use of less expensive, standardized machine elements.

Also of advantage are the embodiments defined in claims 9 to 14 because the use of slide guides enables a clearance-free, smooth and also low-wear bearing to be obtained, and using the specified guide elements also makes assembly and subsequent maintenance easier. It has proved to be of particular advantage to use plastic sections as guide elements, made from plastic material with good sliding properties or sections with an anti-friction layer on the slide surfaces, which results in a particularly low-friction and wear-resistant design of the guide systems.

The advantageous embodiment defined in claim 15 results in a high bending and torsion

resistance due to the fact that I-sections of this type have a high moment of inertia, which means that bending deformation of the telescopic table when accommodating a load and the high bending moments which occur in the extracted state can be kept low, enabling exact positioning and hence a free drive-in height in the shelving, thereby minimizing the empty volume of the warehouse overall.

As a result of another embodiment defined in claim 16, any flexing of storage means, supported in a position higher than the bearing surface of the top table on the endless conveyors running at either side when the telescopic table in the retracted state, does not detrimentally affect their stability on the load-bearing means.

Advantage can be gained from another possible embodiment defined in claim 18 because the guide systems can be simplified, which means that the bottom table structure can be simplified and the construction width of the telescopic table and hence of the load-bearing means as well as the overall intrinsic weight can be reduced.

As a result of the advantageous embodiments defined in claims 19 to 21 , the same high guiding quality as that described above can be achieved in respect of the lateral guide system for the telescopic table components which can be displaced relative to one another.

Also of advantage is an embodiment defined in claim 22, whereby different materials which can be used for the top table and/or bottom table avoid different coefficients of friction and wear factors.

The embodiment defined in claim 23 guarantees a lower construction height for the intermediate table and thus saves on weight.

Claims 24 to 30 described advantageous embodiments, by means of which the storage aids supported on the load-bearing means can be secured without jolting, irrespective of their weight in the empty state or loaded. One possible embodiment in this respect comprises the specified lever arrangement, by means of which a locking means can be automatically switched to a locked position by acting on the load via the storage aid.

As may also be seen from claim 29 in particular, however, it is also possible to use locking means which are displaced by means of an independent drive system, for example an electromagnet.

As a result of the advantageous embodiment defined in claim 30, the storage aid is also secured on the top table of the telescopic table in the retracted state, i.e. when the storage aids are supported on the endless conveyors running at the side of the telescopic table.

The embodiments defined in claims 31 to 33 permit different drive options in order to satisfy the different requirements placed on the drives.

In this respect, claim 34 defines an advantageous embodiment, whereby an extraction length of the telescopic table is made longer, so that the latter is able to move under storage aids in the second row which are not exactly positioned, for example are stowed at a bigger distance from the position of the first row, by a reliable amount of projection.

The embodiments of transmission systems defined in claims 35 and 36 also enable different ways of transmitting movement between the top table and the middle table depending on the relative movement between the middle table and the bottom table and guarantee a transmission ratio of 1:2, i.e. a displacement path and a displacement speed of the middle table relative to the bottom table is transmitted to the top table in a ratio of 1:2.

Claims 37 to 39 define other advantageous embodiments which guarantee exact final positioning of the load-bearing means in the height direction even if there are variances between a theoretical desired position and an actual position of the free retraction section between the storage aids stowed in the shelf due to deformations caused by a changing load state of the shelf, for example, which means that the vertical distance between a top edge of a storage aid and a bottom edge of the storage aid stored on top of it, needed in order to drive the telescopic table in, can be designed with a lower plus tolerance with respect to the structural height of the components to be drive in. This makes it possible to stow the storage aids more densely by reference to the total volume of the warehouse, thereby making it more economic.

The invention further relates to a method of stowing and retrieving goods with storage aids in or from a shelf, of the type outlined in the introductory part of claim 40.

In a known method of stowing and retrieving goods with storage aids in or from shelves using a telescopic load-bearing system, position data for every shelf compartment is stored in a central control system on the basis of X and Y co-ordinates.

The objective of the invention is to propose a method of stowing and retrieving goods with storage aids and a telescopic load-bearing system by means of which more refined end positioning can be achieved rapidly before retracting the telescopic load-bearing means in order to minimize empty storage space.

This objective is achieved by the invention on the basis of the features defined in the characterizing part of claim 40. The surprising advantage of this approach is that significant overall storage volumes can be saved.

Also of advantage are the features defined in claim 41 which result in higher economic efficiency but also guarantee reliable operation for turning goods around.

To provide a clearer understanding, the invention will be described in more detail below with reference to examples of embodiments illustrated in the appended drawings.

Of these:

Fig. 1 is a view in elevation showing a shelving system and a transport system, in particular a shelf-stacking device, with a telescopic load-bearing system proposed by the invention disposed on a loading platform;

Fig. 2 is a schematic diagram showing a plan view of the shelving system illustrated in Fig. 1with the shelf-stacking device;

Fig. 3 is a schematic diagram of a part-region of a shelving system with load-bearing means as proposed by the invention;

Fig. 4 is a plan view of the load-bearing means with the telescopic table driven into a shelf;

Fig. 5 shows a section of the load-bearing means along line V-V indicated in Fig. IV;

Fig. 6 is a front view of a locking mechanism of the load-bearing means proposed by the invention;

Fig. 7 shows a plan view of the locking mechanism;

Fig. 8 shows a front view of the locking mechanism with a load-bearing means to be secured;

Fig. 9 shows a detail of a warehouse shelf with a angled section of the shelf, designed to obtain an adjustment to the actual position of the load-bearing means, viewed in section along line IX – IX indicated in Fig. 4.

Firstly, it should be pointed out that the same parts described in the different embodiments are denoted by the same reference numbers and the same component names and the disclosures made throughout the description can be transposed in terms of meaning to same parts bearing the same reference numbers or same component names. Furthermore, the positions chosen for the purposes of the description, such as top, bottom, side, etc., relate to the drawing specifically being described and can be transposed in terms of meaning to a new position when another position is being described. Individual features or combinations of features from the different embodiments illustrated and described may be construed as independent inventive solutions or solutions proposed by the invention in their own right.

Figs. 1 and 2 is a view in elevation showing a transport system, in particular a shelf-stacking device 1, and a shelving system 2 which in this example comprises a vertical racking system with shelves 3, 3‘ for stowing storage aids 4, in particular containers, boxes, etc.. The shelf-stacking device 1 in this example is designed so that it can be moved in a shelving aisle 5 between two shelves 3 spaced at a distance apart from one another in the alley direction - indicted by double arrow 9 - along rails 7 running along a support surface 6 and

a running gear system, not illustrated, on a head 8 of the shelving system 2 and at least one drive system. Shelf-stacking devices 1 of this type with a load-bearing means 11 which can be moved in the vertical direction – indicated by double arrow 10 - are already generally known from the prior art, for example from patent specifications DE 44 05 952 A1 or DE 195 34 291 A1.

However, it should be pointed out that the load-bearing means 11 proposed by the invention may also be used on other devices, elevator vehicles, etc. in order to service a warehouse or for conveying goods transported in storage aids.

The load-bearing means 11, which can be displaced in the direction of the height of a mast 12 extending perpendicular to the support surface 6, is guided by means of vertical and/or lateral guide members, not illustrated in detail, and can be essentially vertically displaced along the guide tracks by means of a drive system 13. The load-bearing means 11 is equipped with a telescopic table 15 which can be displaced in a plane extending parallel with the support surface 6 – indicated by double arrow 14 – which preferably comprises a bottom table 16, an intermediate table 17 and a top table 18. From its position in the shelving aisle 5, it is used to stow and retrieve storage aids 4 selectively in or from the shelves 3 disposed on either side, which are double-row shelves as illustrated, and to do so irrespectively of whether the load-bearing means 4 adjacent to the shelving aisle 5 or the storage aid 4 farther away from the shelving aisle 5 or both together have to be stowed or retrieved. As may be seen from Fig. 1, each of the shelves 3 has several shelf uprights 19 disposed vertically with respect to the support surface and shelf compartments 20 between them spaced apart from one another in vertical planes. Angled sections 21 are oriented horizontally and parallel with the support surface 6 and enable storage in several rows within a shelf compartment 20. It should be pointed out that the shelves 3 may naturally be provided in the form of individual shelves, although this is not illustrated, but the more economic solution is that of the double shelves illustrated in the embodiment described as an example here.

As also illustrated in Fig. 1, an incoming conveyor system 22, in particular a roller conveyor, is provided upstream of the shelf-stacking device 1, preferably at the beginning and/ or the end of the shelving aisles 5, for transporting the storage aids 4. The storage aids 4 are conveyed in the direction towards the shelf-stacking device 1 – indicated by arrow 23.

Downstream of the shelf-stacking device 1 is an outgoing conveyor system 24, in particular a roller conveyor. The storage aids 4 are transported away from the shelf-stacking device 1 – indicated by arrow 25. Instead of roller conveyors, it would naturally also be possible to use belt conveyors. The incoming conveyor system 22 disposed upstream of the shelf-stacking device 1 may be an accumulation roller conveyor system of a type known from the prior art so that the storage aids 4, e.g. containers, boxes, can be conveyed on the basis of an accumulation system.

As may be seen from Figs. 1 and 2, the top table 18 of the telescopic table 15 can be telescopically extracted and retracted in both directions by reference to the displacement direction of the shelf-stacking device 1. If at least one storage aid 4 has to be transferred from the loading platform 11 into a shelf compartment 20 or transferred from the shelf compartment 20 to the loading platform 11, the shelf-stacking device 1 together with its loading platform 10 is positioned in front of the relevant shelf compartment 20 in the aisle direction – indicated by double arrow 9 – and the vertical direction of the mast 12 so that a bearing surface 26 of the top table 18 for the storage aids 4 is positioned slightly underneath one of the support surfaces 27 formed by the angled sections 21 and centrally in front of the at least one storage aid 4 to be stowed or retrieved. After driving the top table 18 into the shelf 3, the storage aid 4 is lifted by raising the loading platform 11. After the lifting operation, the top table 18 is retracted until it assumes a central position with respect to the stationary bottom table 16.

Alternatively, the load-bearing means 11 can be used to pick up at least one storage aid 4 from the incoming conveyor system 22 and to transfer at least one storage aid 4 disposed on the load-bearing means 11 to the outgoing conveyor system 24 downstream of the shelf-stacking device 1, in which case the shelf-stacking device 1 and the load-bearing means 11 are positioned in front of the incoming or outgoing conveyor system 22; 24 in the aisle direction – indicated by double arrow 9 – and in the vertical direction so that the bearing surface 26 of the top table 18 extends parallel with the support surface 6 and flush with a conveyor plane 28 of the incoming or outgoing conveyor system 22; 24 and the telescopic table 15 is positioned centrally with respect to the at least one storage aid 4 to be picked up, after which the at least one storage aid 4 can be moved onto the telescopic table 15 or moved off it.

Fig. 3 is a simplified, schematic diagram illustrating a region of the shelving system 2 with the stowed storage aids 4, e.g. empty containers 29, and the shelf-stacking device 1 with the load-bearing means 11 incorporating the telescopic table 15. Extending on either side of the telescopic table 15 across a retracted length 30 of the telescopic table 15 is a two-track conveyor with synchronously driven endless conveyors 31, 32 e.g. belt conveyors. A total width 33 approximately corresponds to an external dimension 34 of the storage aid 4. A width 35 of the top table 18 is shorter than a free space between legs 36 of the bearing sections 21 for the storage aids 4 in the shelf 3 extending towards one another and secured to the shelf uprights 19 in the direction extending parallel with the support surface 6 and in the direction of a shelf depth. A distance 37 between the bearing sections 21 spaced apart in the vertical direction of the shelf uprights 19 is bigger than a 1 vertical dimension 39 of the storage aid 4 by the amount of the driving-in height 8 required and the required driving-in height 38 is dependent on a total height 40 of the top table 15 and intermediate table 16 and the positioning accuracy of the loading platform 11 to be obtained. Features enabling the driving-in height 38 to be minimized using control and regulation means will be discussed in more detail below, because these features are very important as a means of minimizing unusable storage capacities and an essential factor in terms of warehouse capacity usage.

Figs. 4 and 5 provide a detailed illustration of the telescopic table 15 disposed on a support frame 41 of the shelf-stacking device 1 and between the endless conveyors 31, 32. It comprises the bottom table 16 secured to the support frame 41, the intermediate table 17 and top table 18. The top table 18 and the intermediate table 17 can be displaced relative to the bottom table 16 and relative to one another in linearly extending guide systems 42, 43, 44, 45, disposed more or less symmetrically with respect to a mid-plane 46 extending vertically and in the displacement direction of the intermediate table 17 and top table 18 and parallel with one another and form spaced-apart guide planes 47, 48 for the displaceable mounting of the top table 18 on the intermediate table 17 and of the intermediate table 17 on the bottom table 16, parallel with the bearing surface 26 of the top table 18.

The guide systems 42, 43, 44, 45 are provided in the form of strip-shaped, stepped side faces 49, 50, 51, 52 projecting out from the intermediate table 17 and guide projections 53 extending across the length 30 and groove-shaped recesses 54 of the top table 18 and of the bottom table 16. In order to obtain the best possible sliding properties and low wear inde-

pendently of the properties of the material used for the bottom table 16, intermediate table 17 and top table 18, special guide elements 55 in the form of anti-friction sections 56 are disposed on the strip-shaped guide projections 53 – preferably attached by a positive or frictional connection and clamping action, one the one hand, and complementary sections 57 enclosing the anti-friction sections 56 in the groove-shaped recesses 54 on the other hand. Accordingly, in a preferred embodiment, U- sections made from plastic with good anti-friction properties are provided as the anti-friction sections 56 and the complementary sections 57 are preferably metal sections. Surfaces acting as sliding surfaces may optionally be provided with a low-friction, wear-resistant coating 58.

In addition to the advantage of improving anti-friction properties and resistance to wear, the guide elements 55 are parts which can be easily replaced in a maintenance situation and also simplify the process of producing the guide projections 53 and the recesses 54 on the tables.

The groove-shaped recesses 54 of the top table 18 are provided in the form of approximately C-shaped contouring of side walls 59 bounding the top table 18 in the width 35.

In order to provide guide systems 44, 45 in which the intermediate table 17 can be guided relative to the bottom table 16, it has support strips 60 extending across the length 30, which are attached to the bottom table 16 and project in the direction of the intermediate table 17 and, facing one another, the groove-shaped recesses 54 for the guide projections 53 incorporating the guide elements 55.

In terms of its cross-section incorporating the integrally formed guide projections 53 constituting the guide planes 47, 48, the intermediate table 17 corresponds to that of an essentially flat I-beam with a top and bottom band, which results in a high section modulus in order to absorb bending force under load in the extracted state.

It is of particular advantage to use by preference fiber-reinforced composite components – or alternatively components incorporating reinforcing elements strengthened with fabric or made from metal - for the intermediate table 17 and the top table 18 for reasons of both bending resistance and achieving a lower weight, as well as cheaper production and mate-

rial options. The fibers which might be used include carbon fibers, glass fibers and Kevlar fibers, for example. The composite material might be plastic, in particular polyester resin by preference. Naturally, it would also be possible to use light metal alloys such as Al or Mg alloys.

In order to achieve a short construction height 61 between a top face 62 of the top table 18 and a bottom face 63 of the bottom table 16, the guide projections 53 also have a stepped offset and a band width 64 of what might be termed the top band is bigger than a band width 65 of what would be termed the bottom band. This results in an offset arrangement of the guide systems 42, 43 and guide systems 44, 45 with respect to the mid-plane 46 and hence a space-saving overall disposition of the guide systems 42, 43 and guide systems 44, 45 and also a space-saving overall construction of the telescopic table 15 and thus the low construction height 61.

In a manner known from the prior art, in order to achieve the relative displacement between the intermediate table 17 and the top table 18 as a function of the relative displacement between the bottom table 16 and the middle table 17 produced by a drive system 66 – which in the embodiment illustrated as an example is a traction drive 67 –transmission systems 68 are provided, with strand-shaped transmission means 70 such as belts, cables, chains, etc., extending round rotatably mounted sprocket wheel means 69 in opposite end regions of the intermediate table 17.

In a known manner, two of these transmission systems 68 are provided in total, in which a respective strand-shaped transmission means 70, such as a cable, belt, chain, etc. in a complementary disposition leads from a fixing means 71 on the top table 18 and round an approximately 180° turn of the sprocket wheel means 69 to another fixing means 72, with the transmission means 70 on the bottom table 16 preferably secured by a clamping mechanism 73.

In order to keep the construction height 61 short for the purpose of the invention, a theoretical transmission plane 76 formed by the sprocket wheel means 69 and by the strands 74, 75 of the transmission means 70 guided by it in opposite directions subtends an angle 77 with the bearing surface 26 of the top table 18, which angle 77 is between approximately 10 ° and 60 °.

It should also be pointed out that, instead of the illustrated transmission system 68 with a disc-shaped sprocket wheel means 69 and a strand-shaped transmission means 70, the same function could be achieved by providing toothed racks fixedly mounted on the bottom table 16 and top table 18 and a number of freely rotatable gears disposed in the intermediate table 17 so that they mesh with the toothed racks.

As may be seen from Fig. 5, in order to provide a relative movement that stays on track, i.e. to counteract a lateral guide clearance, at least one other guide plane 78 is provided perpendicular to the guide planes 47, 48 and parallel with the displacement direction, which in the embodiment illustrated as an example here is provided in the form of two guide systems 79, 80 laterally offset from one another, as described above, and groove-shaped recesses 54 in the intermediate table 17 extending in the longitudinal direction in which the guide projections 53 incorporating the guide elements 58 connected to the top table 18 and the bottom table 16 project. This ensures an exact lateral guidance across the entire displacement path.

However, a corresponding lateral guide and hence the vertically extending guide plane 78 can also be achieved by designing the guide systems 42, 43, 44, 45 with virtually no lateral clearance.

As mentioned above, the drive system 66 in the embodiment illustrated as an example here is a traction drive 67 with an endlessly circulating multiple chains, in particular a triplex chain, disposed on the bottom table 16 and has a chain strand 82 guided parallel with a bottom face 81 of the intermediate table 17. External chains of the triplex chain are guided by means of drive and sprocket wheel gears, whilst the middle strand is secured to the bottom face 81 of the intermediate table 17 and meshes with toothed racks 83 extending in the direction of the longitudinal extension. In order to produce high driving forces and in particular to absorb high acceleration and deceleration forces, the chain may be what is known as a quad chain which meshes with two toothed racks extending parallel.

With a drive system of this type in which the driving and sprocket gears mesh with external strands of the chain and at least one middle chain strand meshes with the toothed rack

38 across the entire length of the run, the total displacement path of the telescopic table 15 can be made longer than is the case with a chain drive with an endlessly circulating chain by some 10% to 25%, reducing the limit of an overlap needed in the guide systems. This extension of the total displacement path therefore increases the range of the telescopic table, so that in the event of double storage, the top table can be reliably moved underneath the storage aid deposited in the second position, even if it has been deposited slightly farther away from the shelf middle than intended as standard.

This results in a tried and tested drive system 66, although it should be pointed out that other solutions may naturally also be used for the drive, including, amongst other examples, a spindle drive or a rack and pinion gear.

Generally speaking, it should be said that the design of the shelf-stacking device 1 with the loading platform 11 and the telescopic table 15, in particular due to the lightweight construction of the loading platform 11, is intended to provide high transport efficiency due to high displacement speeds, in order to minimize stowage and retrieval times. In order to take account of the high accelerations needed for this purpose and the inertial forces which occur as a result, a locking mechanism 86 is provided at opposite end regions 84, 85 of the top table 18, as a means of securing the storage aid 4 to prevent it from falling off the telescopic table 15, as may be seen from Figs. 4 and 5, which is preferably provided on the longitudinal side walls 59 of the top table 18.

Figs. 6 and 7 described below illustrate a detail of one possible design of a locking mechanism 86 whilst Fig. 8 illustrates the operating mode for securing a storage aid 4 accommodated on the top table 18.

In this example of an embodiment, the locking mechanism 86 is a lever arrangement with a single lever element 89 which can be pivoted relative to the top face 62 of the top table 18 about parallel pivot axes 87 and about another pivot axis 88, and a double lever element 91 with a catch pawl 90. The locking mechanism 86 also has a spring system 92 and a stop means 93, by means of which a basic position of the single lever element 89 extends by means of an operating region 94 spaced at a distance apart from the pivot axis 87 beyond the top face 62 of the top table 18, and in this position is positioned by the spring force of

the spring system 92 against the stop means 93, in particular against a stop bolt 95 projecting along the side wall 59. The single lever element 89 is displaceably connected to the double lever element 91 in a mutually engaging slide block system 96. Opposite the slide block system 96 by reference to the pivot axis 88 of the double lever element 91, the other lever has a hook-shaped lock projection 97, which does not project beyond the top face 62 of the top table 18 in the basic position.

As may be seen from Fig. 8, when the storage aid 4 is accommodated on the top table 18, the double lever element 91 is pivoted with the operating region 94 against the action of the spring system 92 about the pivot axis 87 due to the weight of the storage aid 4 into a position in which the operating region 94 is flush with the top face 62. Due to the slide block system 96 between the single lever element 89 and the double lever element 91, this causes a pivoting movement of the double lever element 91 about the pivot axis 88, as a result of which the hook-shaped lock projection 97 is moved into the end position in which it projects above the top face 62 of the top table 18 by a hook height 98 and thus secures the storage aid 4, preventing it from slipping as the top table 18 is displaced – as indicated by arrow 99.

It should be pointed out that such locking mechanisms 86 are provided on both side walls 59 and the end region 84, 85, so that the storage aid is reliably secured on the top table 18 irrespective of the direction in which the top table 18 is displaced.

It should also be pointed out that the described locking mechanism 86 is but one embodiment and that it would also be perfectly possible to use other designs whereby a locking mechanism is moved in a vertical direction with respect to the top face 62 of the top table from a position in which it does not project beyond the top face 62 into a position in which it does project beyond it. Naturally, this locking mechanism could also be operated by means of a separate drive, for example by means of an electromagnet or electric motor.

With regard to the hook height 98 by which there is a projection above the bearing surface 26 of the top table 18, it is necessary to make allowance for a distance 100 by which the support surface 101 of the storage aid 4 on the endless conveyor 31, 32 - which is a two-track conveyor as mentioned above - stands above the bearing surface 26 - as may be seen

from Fig. 5 - because the storage aids 4 lie on the slightly raised support surface 101 of the endless conveyors 31, 32 when the telescopic table 15 is in the retracted state. Allowance must therefore be made for this distance 100 when choosing the dimensions of the hook height 98.

To add to the explanations given in connection with Fig. 4, an inventive embodiment of the angled sections 21 for supporting the storage aids 4 in the shelf 3 will be explained in more detail with reference to Fig. 9. Accordingly, a leg 102 is provided on at least one of the oppositely lying angled sections 21 by means of which it is secured to the shelf upright 19, at its end region facing the load-bearing means 11, forming an inlet ramp due to an angled design and, adjoining it in the form of another geometric development, a flat positioning point 103 in a plane extending perpendicular to the displacement direction of the telescopic table 15 – indicated by double arrow 14. This positioning point 103 is therefore of a height 104 corresponding to a leg height of the angled section 21.

A height distance 105 extending in the vertical direction between the support surfaces 27 of the angled sections 21 thus corresponds to the vertical dimension 39 of the storage aids 4 plus the requisite driving-in height 38, which is made up of the total height 40 of the intermediate table 17 and the top table 18 plus a safety space which depends on the positioning accuracy of the shelf-stacking device 1 with the load-bearing means 11.

In order to keep this positioning accuracy within the narrowest limits and thus minimize the non-usable empty storage capacity, a preferably optical electronic position detecting unit 106 equipped with light sensors 107 facing the positioning point 103 is provided on the load-bearing means 11, preferably on the stationary bottom table 16 mounted by means of a strut.

The position detecting unit 106 is preferably provided with two light sensors 107disposed facing one another at a vertical distance 109, which distance 109 is slightly smaller than the height 104 of the positioning point 103.

The purpose of such a layout and design of a position detecting unit 106 in conjunction with a control unit 110 which has an integrated computer 111 and is connected to a pri-

mary central computer 112 via cables or, as illustrated here, wirelessly and has a signaling connection to the control and regulating unit 113 of the shelf-stacking device 1, is to obtain a fine positioning of the load-bearing means 11 from a theoretically pre-set desired position to an actual position by reference to the shelf space, thereby enabling the drive-in cross-section for the load-bearing means 11 to be minimized.

Depending on the type of light sensors used, another option would be to provide reflective light sensors, in which case the distance 109 should be selected so that it is slightly shorter than the height 104.

The described layout is crucial to a fine positioning of the load-bearing means 11 in the Y axis, the broken lines in Fig. 9 showing the position of the light sensors 107 after a desired positioning operation and the solid lines illustrating the situation after adjusting the position to the ACTUAL position, as will be described in more detail below.

However, a fine positioning system of this type may also be used for the X axis, in which case such positioning points 103 are preferably provided on both of the angled sections 21 lying opposite one another and two position detecting units 106 are provided on the load-bearing means 11, which are placed more or less in the middle between the light sensors 107 set at the distance 109, as may be seen from Fig. 9, and at least one other light sensor 107 is provided, which scan a cut-out 115 in the positioning point 103 in pairs, for example, in order to detect any deviation in position in the X axis.

In principle, the load-bearing means 11 is moved on the basis of a rule conforming to positional data stored in the central computer 112, in other words on the basis of a desired position, for retrieving the storage aid 4. In order to make allowance for any variances between the desired position and the current actual position, such as might occur due to bearing loads, heat expansion of the shelf system and the bodywork, the signals of the light sensors 107 obtained by means of the position detecting unit 106 are analyzed in the control unit 110 or in the central computer 112 in accordance with a stored position matrix, which results in appropriate activation commands for the drive systems of the shelf-stacking device 1 to displace it in the direction of the X axis and of the load-bearing means 11 and to displace it in the Y axis and thus regulate it to the exact actual position on the basis of the

signals from the optical electronic detection unit 106, where the light beams 114 emitted by the light sensors 107 hit the surface 108 of the positioning points 103.

The embodiments illustrated as examples represent possible design variants of the load-bearing means and it should be pointed out at this stage that the invention is not specifically limited to the design variants specifically illustrated, and instead the individual design variants may be used in different combinations with one another and these possible variations lie within the reach of the person skilled in this technical field given the disclosed technical teaching. Accordingly, all conceivable design variants which can be obtained by combining individual details of the design variants described and illustrated are possible and fall within the scope of the invention.

For the sake of good order, finally, it should be pointed out that, in order to provide a clearer understanding of the structure of the load-bearing means, it and its constituent parts are illustrated to a certain extent out of scale and/or on an enlarged scale and/or on a reduced scale. The objective underlying the independent inventive solutions may be found in the description.

Above all, the individual embodiments of the subject matter illustrated in Fig. 1 to 9 constitute independent solutions proposed by the invention in their own right. The objectives and associated solutions proposed by the invention may be found in the detailed descriptions of these drawings.

List of reference numbers

1	Shelf-stacking device	31	Endless conveyor
2	Shelving system	32	Endless conveyor
3	Shelf	33	Total width
4	Storage aid	34	External dimension
5	Shelving aisle	35	Width
6	Support surface	36	Leg
7	Rail	37	Distance
8	Head	38	Driving-in height
9	Double arrow	39	Vertical dimension
10	Double arrow	40	Total height
11	Load-bearing means	41	Support frame
12	Mast	42	Guide system
13	Drive system	43	Guide system
14	Double arrow	44	Guide system
15	Telescopic table	45	Guide system
16	Bottom table	46	Mid-plane
17	Intermediate table	47	Guide plane
18	Top table	48	Guide plane
19	Shelf upright	49	Side face
20	Shelf compartment	50	Side face
21	Angled section	51	Side face
22	Incoming conveyor system	52	Side face
23	Arrow	53	Guide projection
24	Outgoing conveyor system	54	Recess
25	Arrow	55	Guide element
26	Bearing surface	56	Anti-friction section
27	Support surface	57	Complementary section
28	Conveyor plane	58	Coating
29	Empty container	59	Side wall
30	Length	60	Support strip

61 Construction height
62 Top face
63 Bottom face
64 Band width
65 Band width
66 Drive system
67 Traction drive
68 Transmission system
69 Pulley block means
70 Transmission means
71 Fixing means
72 Fixing means
73 Clamping mechanism
74 Strand
75 Strand
76 Transmission plane
77 Angle
78 Guide plane
79 Guide system
80 Guide system
81 Bottom face
82 Chain strand
83 Toothed rack
84 End region
85 End region
86 Locking mechanism
87 Pivot axis
88 Pivot axis
89 Single lever element
90 Catch pawl
91 Double lever element
92 Spring system
93 Stop means
94 Operating region
95 Stop bolt
96 Slide block system
97 Lock projection
98 Hook height
99 Arrow
100 Vertical distance
101 Support surface
102 Leg
103 Positioning point
104 Height
105 Height distance
106 Position detecting unit
107 Light sensor
108 Surface
109 Distance
110 Control unit
111 Computer
112 Central computer
113 Control and regulating unit
114 Light beam
115 Cut-out